IN THE SPECIFICATION:

Paragraph beginning at line 3 of page 1 has been amended as follows:

The present invention relates to a ~~superconductive~~ superconducting radiation detector, and to a method of manufacturing a calorimeter having a membrane for controlling thermal conductivity and arranged a specified distance from a substrate.

Paragraph beginning at line 7 of page 1 has been amended as follows:

Currently, development of calorimeters using ~~superconductive transfer terminals~~ a superconducting transition edge is being carried out in various research laboratories. As a reference publication, there is, for example, Applied Physics Letters 66,1988(1995). In this publication, a calorimeter comprises an ~~absorbent~~ absorber for absorbing radiation and converting energy of the radiation into thermal energy, a ~~resistor,~~ resistor attached to the ~~absorbent,~~ absorber for converting the thermal energy into an electrical signal, and a membrane for externally discharging heat. The calorimeter maintains a steady state by balancing joule heat generated by electrical current flowing in the

resistor and heat discharged to the outside through the membrane. The membrane applies micromachining technology, and uses a thin insulator ~~of~~ under 1 μm. A silicon nitride film is used as the insulator.

Paragraph beginning at line 21 of page 1 has been amended as follows:

A conventional membrane production method uses a silicon substrate on which at least ~~a single surface~~ a silicon nitride film is ~~formed~~ deposited on one side of the silicon substrate, and after manufacturing an ~~absorbent~~ absorber and a resistor on the surface of the formed silicon nitride film, the silicon is etched from the ~~rear~~ back surface (reference publication IEEE Trans. Appl. Super. 5,2690(1995)). With the conventional manufacturing method, it is necessary to perform double surface patterning, because the silicon is etched from the ~~rear~~ back surface. As a result, since both surfaces of a wafer are grounded to an exposure device holder, there is a danger of elements being contaminated. Further, if the silicon is etched from a ~~rear~~ back surface, in order to completely etch the thick parts of the wafer it has been considered to ~~increase~~ degrade mechanical strength. In particular, when a calorimeter is arrayed, there is a need to etch from the ~~rear~~ back surface only for the array number, and

it has been considered to further improve the mechanical strength of the whole substrate. A manufacturing method for a membrane using a conventional sacrificial layer is also shown. A sacrificial layer is formed on the substrate, an insulating film is formed on the sacrificial layer and the sacrificial layer is etched to form a membrane. However, if this method is used, a stepped region is inevitably formed on part of the membrane, and it is difficult to maintain the mechanical strength of the stepped membrane as it is easy for cracks and the like to occur.

Paragraph beginning at line 2 of page 3 has been amended as follows:

In order to solve these type of problems, there is provided a calorimeter having an ~~absorbent,~~ absorber for converting energy of radioactive rays into ~~heat~~ thermal energy, and a ~~resistor,~~ resistor for converting ~~heat~~ thermal energy into an electrical signal using ~~superconductive~~ superconducting ~~transition,~~ transition and arranged on a membrane for ~~determining thermal conductivity~~ controlling thermal discharge from the resistor. ~~and having the~~ The membrane is attached to a substrate~~, the substrate~~ having a tri-layer structure of an etching layer, an etching stop layer and a support substrate, with the membrane being arranged

separated by the thickness of ~~the etching stop layer and~~ the etching layer apart from the etching stop layer.

Paragraph beginning at line 14 of page 3 has been amended as follows:

As a result, ~~a~~ the support substrate exists at a lower portion maintaining a specified distance from the membrane. If the thickness of the etching layer is, for example, 30 μm, and the support substrate is, for example, 500 μm, the mechanical strength of the substrate after etching the etching layer is sufficiently strong because the support substrate is sufficiently thick compared to the etching layer. If the membrane is bridged, it is possible to obtain a membrane having a degree of thermal conductivity according to design parameters by varying the length and thickness. By using a substrate having a tri-layer structure of an etching layer, an etching stop layer and a support substrate, and forming elements on a membrane formed as a film on the etching layer side, elements and membrane patterning are on the same surface, and there is no danger of contaminating the pattern surface.

Paragraph beginning at line 4 of page 4 has been am nded as follows:

There is also provided a manufacturing method for a ~~calorimeter,~~ calorimeter having an ~~absorbent,~~ absorber for converting energy of radioactive rays into ~~heat~~ thermal energy, and a ~~resistor,~~ resistor for converting ~~heat~~ thermal energy into an electrical signal using a ~~superconductive~~ superconducting ~~transition,~~ transition and arranged on a membrane for ~~determining thermal conductivity~~ controlling thermal discharge from the resistor~~, and having the~~. The membrane is attached to a substrate~~, the substrate~~ having a tri-layer structure of an etching layer, an etching stop layer and a support substrate~~, including the step of arranging~~. According to the present invention, the membrane is arranged in a specified direction and ~~etching~~ the etching layer is etched from the etching layer side.

Paragraph beginning at line 16 of page 4 has been amended as follows:

As a result, it is possible to more easily perform wet etching of the etching layer underneath the membrane, and it is possible to have the membrane separated by the thickness of ~~the support substrate and~~ the etching layer apart from the support substrate. In particular, by forming the etching

layer from planar (100) oriented silicon, and arranging the orientation of the membrane to <100>, it is made possible to etch the etching layer in a short time.

Paragraph beginning at line 24 of page 4 has been amended as follows:

There is also provided a manufacturing method for a ~~calorimeter,~~ calorimeter having an ~~absorbent,~~ absorber for converting energy of radioactive rays into ~~heat~~ thermal energy, and a ~~resistor,~~ resistor for converting ~~heat~~ thermal energy into an electrical signal using a ~~superconductive~~ superconducting ~~transition,~~ transition and arranged on a membrane for ~~determining thermal conductivity~~ controlling thermal discharge from the resistor~~, and having the~~. The membrane is attached to a substrate~~, the substrate~~ having a tri-layer structure of an etching layer, an etching stop layer and a support substrate~~, comprising the steps of providing~~. According to the present invention, a hollow is provided at part of the etching layer, ~~depositing~~ a sacrificial layer is deposited, ~~flattening~~ a surface of the etching layer is flattened, and ~~etching~~ the etching layer is etched from the etching layer side.

Paragraph beginning at lin 12 of page 5 has been amended as follows:

Since the ~~rear~~ back surface of the etching layer is flattened, no stepped portion is caused in the membrane formed after etching of an amorphous material constituting the sacrificial layer. Therefore, there is no effect of cracks or the like occurring in a stepped portion of the membrane, which means that the mechanical strength of the membrane is improved. Also, since the amorphous layer does not have crystallinity, the etching rate is also fast. As a result, it is possible to reduce the time taken to manufacture a calorimeter. Also, since the amorphous layer does not have crystallinity, it is possible to freely choose the shape of the membrane, and it is easy to adjust the thermal conductivity.

Paragraph beginning at line 15 of page 7 has been amended as follows:

Fig. 1 is a schematic diagram of a calorimeter having an ~~absorbent,~~ absorber for converting energy of radioactive rays into ~~heat~~ thermal energy, and a ~~resistor,~~ resistor for converting ~~heat~~ thermal energy into an electrical signal using ~~superconductive~~ superconducting ~~transition,~~ transition and arranged on a membrane for ~~determining thermal~~

~~conductivity~~ controlling thermal discharge from the resistor~~, and having the~~. The membrane is attached to a substrate~~, the substrate~~ having a tri-layer structure of an etching layer, an etching stop layer and a support substrate~~, with the~~. The membrane ~~being~~ is arranged separated by the thickness of ~~the etching stop layer and~~ the etching layer apart from the etching stop layer.

Paragraph beginning at line 3 of page 8 has been amended as follows:

FIG. 1B is a schematic drawing looking at an element from an ~~absorbent~~ absorber 6. FIG. 1A is a cross section taken along the dotted line ~~on~~ in FIG. 1B.

Paragraph beginning at line 6 of page 8 has been amended as follows:

A calorimeter 1 has a resistor 5, an ~~absorbent~~ absorber 6 and ~~superconductive~~ superconducting wiring 7 laminated on a membrane 4 ~~arranged so that part of an etching layer 2 traverses an etched hole 3~~ which traverses a hole 3 that is fabricated by etching of a part of etching layer 2.

Paragraph beginning at lin 11 of page 8 has b en amend d as follows:

A substrate 8 has a tri-layer structure comprising an etching layer 2, and etching stop layer 9 and a support substrate 10. A Silicon On Insulator (SOI) wafer can be used as the substrate 8. An SOI substrate has a tri-layer structure comprising a thin silicon layer, an oxidation film and a thick silicon substrate. It is possible to use the thin silicon layer as the etching layer 2, the oxidation film as the etching stop layer 9, and the thick silicon substrate as the support substrate 10. It is preferable to make the etching layer 2 sufficiently thick so that the membrane 4 and the etching stop layer 9 are sufficiently spaced apart, but in order to prevent the time required to etch the etching layer 2 being too long, the thickness is preferably a few tens of ~~microns~~ <u>μm</u>. It is sufficient for the etching stop layer 9 to have a thickness of 0.1 ~~microns~~ <u>μm</u>, provided the selection ratio for etching of the etching layer 2 if sufficiently large. The support substrate 10 is preferably at least a few hundred microns, in order to increase the mechanical strength of the microcalorimeter 1. It is possible to select, for example, silicon nitride film as the material of the membrane 4. The membrane 4 is arranged separated by the thickness of ~~the etching stop layer 9 and~~ the etching layer 2 <u>apart from</u>

the etching stop layer 9. As a result, a support substrate exists at a lower portion maintaining a specified distance from the membrane. If the thickness of the etching layer is, for example, 30 μm, and the support substrate is, for example, 500 μm, the mechanical strength of the substrate after etching the etching layer is sufficiently strong because the support substrate is sufficiently thick compared to the etching layer.

Paragraph beginning at line 7 of page 10 has been amended as follows:

In the above described manner, by making a calorimeter having an ~~absorbent,~~ absorber for converting energy of radioactive rays into ~~heat~~ thermal energy, and a ~~resistor,~~ resistor for converting ~~heat~~ thermal energy into an electrical signal using ~~superconductive~~ superconducting ~~transition,~~ transition and arranged on a membrane for determining thermal conductivity, ~~and having~~ the membrane being attached to a substrate~~, the substrate~~ having a tri-layer structure of an etching layer, an etching stop layer and a support substrate, and with the membrane being arranged separated by the thickness of ~~the etching stop layer and~~ the etching layer apart from the etching stop layer, it is possible to obtain a calorimeter that has elements of a large mechanical strength compared to using the silicon substrate of

the related art, and which is suitable for making into an array.

Paragraph beginning at line 23 of page 10 has been amended as follows:

Fig. 2 - Fig. 5 are schematic drawings of manufacturing method for a ~~calorimeter,~~ calorimeter having an ~~absorbent,~~ absorber for converting energy of radioactive rays into ~~heat~~ thermal energy, and a ~~resistor,~~ resistor for converting ~~heat~~ thermal energy into an electrical signal using ~~superconductive~~ superconducting ~~transition,~~ transition and arranged on a membrane for ~~determining thermal conductivity~~ controlling thermal discharge from the resistor, ~~and having~~ the membrane being attached to a substrate~~, the substrate~~ having a tri-layer structure of an etching layer, an etching stop layer and a support substrate, including the ~~step~~ steps of arranging the membrane in a specified direction and etching the etching layer from the etching layer side.

Paragraph beginning at line 15 of page 11 has been amended as follows:

It is possible to use an SOI (Silicon On Insulator) substrate as the substrate 24. An SOI substrate has a tri-layer structure comprising a thin silicon layer, an oxidation

film and a thick silicon substrate. It is possible to use the thin silicon layer as the etching layer 21, the oxidation film as the etching stop layer 22, and the thick silicon substrate as the support substrate 23. FIG 2B is a schematic drawing looking from the side of the insulating film 25 in FIG. 2A. The planar orientation of the SOI substrate is preferably a (100) plane. The insulating film 25 formed on the SOI substrate can use, for example, a silicon nitride film. The insulating film 25 is also formed on the etching layer 21 side of the SOI substrate. As film formation means, it is possible to use, for example, LPCVD ~~(low pressure chemical vapor deposition)~~ (Low Pressure Chemical Vapor Deposition), Plasma-CVD or sputtering. However, it is preferable to make the film stress as low as possible. The thickness of the insulating film 25 is dependent on the ~~heat~~ thermal conductance design parameters, ~~but~~ however is preferably from 1 μm - 2 μm. Next, the design method for the etching mask 26 will be described. It is necessary for the material used for the etching mask 26 to be selected as a material that has ~~etching resistance~~ adequate rate of selectivity with respect to etching of the insulating film 25. If the insulating film 25 is a silicon nitride film, it is possible to remove by dry etching, such as RIE ~~(reactive ion etching)~~ (Reactive Ion Etching). In this case, it is possible to use, for example, aluminum or resist

as the material of the etching mask 26. The shape of the etching mask 26 can be selected in a triangular pattern, such as is shown, for example, in FIG. 2B. However, the shape of the etching mask 26 is not limited to that shown in FIG. 2B.

Paragraph beginning at line 7 of page 13 has been amended as follows:

FIG. 4A is a schematic drawing showing a process of stripping the etching mask after the processing of FIG. 3A, and forming a resistor 27 and ~~absorbent~~ <u>absorber</u> 28 on the insulating film 25 formed ~~in~~ <u>as</u> a bridge shape. FIG. 4B is a schematic drawing looking from the direction of the insulating film 25 in FIG. 4A. FIG. 4A is a cross section ~~taken~~ along the dotted line in FIG. 4B. A calorimeter ~~is made up~~ <u>comprises</u> ~~of~~ an ~~absorbent~~ <u>absorber</u> 28 for converting an externally input signal to ~~heat~~ <u>thermal energy</u>, and a resistor 27 whose resistance value varies with ~~heat~~ <u>Joule heat around the transition temperature</u>, and which converts an externally input signal to an electrical signal. The externally input ~~signal~~ <u>signals</u> ~~has~~ <u>are</u>, for example, radioactive rays or <u>the material with</u> kinetic energy. It is possible to use a ~~double layer structure~~ <u>bilayer</u> superconductor~~, having~~ <u>or</u> or a single layer superconductor ~~or an ordinary conductor layer laminated on a superconductor layer,~~ as the resistor. In the

case of a ~~double layer~~ bilayer structure, it is possible to design the ~~superconductivity~~ superconducting transition temperature by varying the ratio of film thicknesses of the ~~ordinary~~ normal conductor layer and the superconductor layer. It is also possible for a single layer superconductor to have the functions of both the ~~absorbent~~ absorber 28 and the resistor 27.

Paragraph beginning at line 6 of page 14 has been amended as follows:

If the resistor 27 and the ~~absorbent~~ absorber 28 are selected as, for example, titanium and gold, they can be made in the following manner. In FIG. 3A, after ~~etching~~ patterning of a silicon nitride film, being the insulating film 25, has been completed, aluminum, being the etching mask 26, is removed. It is possible for the aluminum to be etched using an alkali solution. Next, titanium, being the resistor 27, is film formed on the insulating film 25 side. The film formation method is sputtering or vacuum evaporation. After formation of the titanium film, a film of gold is formed without ~~releasing~~ breaking the vacuum. Next, patterning of the gold and titanium is performed using mask exposure. It is possible for the gold to be etched using KI (potassium iodide) + I, and to etch the titanium using a hydrogen fluoride

solution. After that, ~~superconductor~~ superconducting wiring 29 is formed as an electrode. It is possible, for example, to use niobium as the ~~superconductor~~ superconducting wiring 29, and for patterning to use a lift-off method.

Paragraph beginning at line 4 of page 15 has been amended as follows:

A fluid for etching the SOI substrate can be, for example, ~~hydrazine,~~ an aqueous solution of hydrazine, an aqueous solution of KOH (potassium hydroxide), or tetraalkylammonium hydroxide (TMAH). The temperature of the liquid is set to 50 - 100 degrees. If the planar oriented (100) SOI substrate is etched, a silicon surface having a planar orientation (111) having a slower etching rate than the planer orientation (100) appears on an edge ~~in~~ along with a horizontal or vertical direction, with respect to an orientation ~~flat and center direction~~. A surface exponent appearing at an edge that is not horizontal or vertical to the orientation ~~flat and center direction~~ becomes other than the (111) plane. (221) and (311) are made to appear by selecting the ~~edge angle in a <100> direction with respect to orientation flat and center~~ direction of membrane to <100>. These surfaces have a fast etching rate compared to (111), which means that silicon below the membrane 30 is etched

faster than in the <100> orientation. Etching in the depth direction is prevented by the etching stop layer 22 being formed on the ~~SOI~~ Si substrate. As described above, differing from the related art, it is possible to manufacture the membrane 30 using patterning and etching from a single surface. Thermal conductivity of the membrane can be controlled by the shape and thickness of the insulating film. Therefore, the thermal conductivity can be freely designed. Also, it is possible to make the shape of the membrane 30 any shape such as a rhomboid or a trapezoid etc. by varying the pattern of the etching mask 26 of FIG. 5A.

Paragraph beginning at line 6 of page 16 has been amended as follows:

As described above, an ~~absorbent~~ absorber, for converting energy of radioactive rays into ~~heat~~ thermal energy, and a resistor, for converting ~~heat~~ thermal energy into an electrical signal using ~~superconductive~~ superconducting transition are arranged on a membrane for determining thermal conductivity, the membrane is attached to a substrate, the substrate has a tri-layer structure of an etching layer, an etching stop layer and a support substrate, and by using a step of arranging the membrane in a specified direction and wet etching the etching layer underneath the

membrane it is possible to easily perform etching, and it is possible to arrange the membrane separated by the thickness of ~~the support substrate and~~ the etching layer. In particular, by forming the etching layer from planar (100) oriented silicon, and arranging the orientation of the membrane to <100>, it is made possible to etch the etching layer in a short time. By using a substrate having a tri-layer structure, patterning is only performed on one surface, and there is no danger of the pattern surface being contaminated. Also, since only the etching layer of the tri-layer structure substrate is etched, the mechanical strength is improved, and it becomes easier to handle.

Paragraph beginning at line 3 of page 17 has been amended as follows:

Fig. 6 - Fig. 11 are schematic diagrams of a manufacturing method for a calorimeter, having an ~~absorbent,~~ absorber for converting energy of radioactive rays into ~~heat~~ thermal energy, and a ~~resistor,~~ resistor for converting ~~heat~~ thermal energy into an electrical signal using ~~superconductive~~ superconducting ~~transition,~~ transition and arranged on a membrane for determining thermal conductivity, ~~and having~~ the membrane being attached to a ~~substrate,~~ substrate ~~the substrate~~ having a tri-layer structure of an etching layer, an

etching stop layer and a support substrate, comprising the steps of providing a hollow at part of the etching layer, depositing a sacrificial layer, flattening a surface of the etching layer, and etching the etching layer from the etching layer side.

Paragraph beginning at line 16 of page 17 has been amended as follows:

FIG. 6A is a schematic diagram of a process of forming an etching mask ~~A55~~ <u>55</u> on a substrate 54 having a tri-layer structure comprising an etching layer 51, an etching stop layer 52 and a support substrate 53, and providing a hollow <u>portion 56 (hereinafter referred to as a "hollow")</u> at part of the etching layer 51. It is possible to use an SOI ~~(silicon on insulator)~~ <u>(Silicon On Insulator)</u> substrate as the substrate 54. An SOI substrate has a tri-layer structure comprising a thin silicon layer, an oxidation film and a thick silicon substrate. It is possible to use the thin silicon layer as the etching layer 51, the oxidation film as the etching stop layer 52, and the thick silicon substrate as the support substrate 53.

Paragraph b ginning at lin 2 of page 18 has b n amended as follows:

FIG. 6B is a schematic drawing looking from the etching mask ~~A55~~ 55 side of FIG. 6A. The planar orientation of the SOI substrate is preferably a (100) plane. It is necessary for the material used for the etching mask ~~A55~~ 55 to be selected as a material that has ~~etching resistance~~ adequate rate of selectivity with respect to etching of the insulating film 25. In this case, it is possible to use, for example, aluminum or resist as the material of the etching mask ~~A55~~ 55. The shape of the etching mask ~~A55~~ 55 can be selected in a rectangular pattern, such as is shown, for example, in FIG. 6B. However, the shape of the etching mask ~~A55~~ 55 is not limited to that shown in FIG. 6B. The hollow 56 is obtained by etching the etching layer 51 where the etching mask ~~A55~~ 55 is not formed. The etching method can be dry etching or wet etching. If an SOI substrate ~~having~~ with a planar orientation of (100) is etched using wet etching, etching in a direction vertical to the plane orientation is stopped by the etching stop layer 52. Also, in the case where the orientation of each edge of the etching mask ~~A55~~ 55 is <110>, the planar orientation of a side wall 57 becomes (111) and is hardly etched. Also, in the case where the desired thickness of the hollow 56 is thinner than the thickness of the etching layer

51, there is no problem even if etching is completed before reaching the etching stop layer 52.

Paragraph beginning at line 25 of page 18 has been amended as follows:

FIG. 7A is a schematic drawing showing a step of depositing a sacrificial layer 58 on the hollow 56, and flattening a surface of the etching layer 51. It is possible to have silicon oxide or silicon, for example, as the material of the sacrificial layer 58. It is also possible to have an organic material as the material of the sacrificial layer 58. It is possible to use sputtering, CVD or evaporation as a method for depositing the silicon oxide or the silicon. Deposition of the sacrificial layer 58 is carried out until the hollow 56 is buried. After the hollow 56 has been buried, it is possible to use, for example, CMP ~~chemical mechanical polishing~~ (Chemical Mechanical Polishing) technique as means for flattening the surface of the etching layer 51. CMP involves a chemical reaction utilizing an abrasive, and is capable of performing flattening of the substrate surface to a nanometer order by mechanical etching using friction.

Paragraph beginning at lin 15 of page 19 has been amended as follows:

Fig. 8 is a schematic drawing showing formation of an insulating film 59 on an SOI substrate that has been flattened, and formation of an etching mask ~~B60~~ <u>60</u> on the insulating film 59. FIG. 8B is a schematic drawing looking from the side of the insulating film 59 in FIG. 8A. The planar orientation of the SOI substrate is preferably (100). The insulating film 59 formed on the SOI substrate can be, for example, a silicon nitride film. The insulating film 59 is also formed on the etching layer 51 side of the SOI substrate. As film formation means, it is possible to use, for example, LPCVD ~~(low pressure chemical vapor deposition~~ <u>(Low Pressure Chemical Vapor Deposition)</u>, Plasma-CVD or sputtering. However, it is preferable to make the film stress as low as possible. The thickness of the insulating film 59 is dependent on the heat conductance design parameters, but is preferably from 1 μm - 2 μm. Next, a method for designing the etching mask ~~B60~~ <u>60</u> will be described. It is necessary for the material used for the etching mask ~~B60~~ <u>60</u> to be selected as a material that has ~~etching resistance~~ <u>adequate rate of selectivity</u> with respect to etching of the insulating film 59. If the insulating film 59 is a silicon nitride film, it is possible for it to be removed by dry etching, such as RIE

~~(reactive ion etching)~~ (Reactive Ion Etching). In this case, it is possible to use, for example, aluminum or resist as the material of the etching mask ~~B60~~ 60. The shape of the etching mask ~~B60~~ 60 can be selected in a rectangular pattern, such as is shown, for example, in FIG. 8B. However, the shape of the etching mask ~~B60~~ 60 is not limited to that shown in FIG. 8B.

Paragraph beginning at line 26 of page 20 has been amended as follows:

Next, a process for etching the insulating film 59 is shown in Fig. 9. FIG. 9A is a schematic diagram of etching of the insulating film 59 in FIG. 9A, and FIG. 9B is a schematic diagram looking from the direction of the insulating film 59. If the insulating film 59 is a silicon nitride film, it is possible to etch using RIE. It is possible to use, for example, a mixed gas of SF6 and ~~02~~ O_2 as an etching gas. If, for example, RIE power is a few tens of W, gas flow amount is less than 100 sccm, a ratio of SF6 and ~~02~~ O^2 flow amount is 5:1, and pressure is a few Pa, it is possible to obtain a selection ratio for the SOI substrate, and it is possible to etch the insulating film 59.

Paragraph b ginning at lin 3 of page 21 has been am nded as follows:

FIG. 10A is a schematic drawing showing a process of stripping the etching mask ~~B60~~ 60 after the processing of FIG. 9A, and forming a resistor 61 and ~~absorbent~~ absorber 62 on the insulating film 59 formed in a bridge shape. FIG. 10B is a schematic drawing looking from the direction of the insulating film 59 in FIG. 10A. FIG. 10A is a cross section ~~taken~~ along the dotted line in FIG. 10B. A calorimeter ~~is made up of~~ comprises an ~~absorbent~~ absorber 62 for converting an externally input signal to ~~heat~~ thermal energy, and a resistor 61 whose resistance value varies with ~~heat~~ thermal energy, and which converts an externally input signal to an electrical signal. The externally input signal has, for example, radioactive rays or the material with kinetic energy. It is possible to use a ~~double layer structure superconductor, having~~ bilayer or a single layer superconductor ~~or an ordinary conductor layer laminated on a superconductor layer,~~ as the resistor. In the case of a ~~double layer structure~~ bilayer, it is possible to design the ~~superconductivity~~ superconducting transition temperature by varying the ration of film thicknesses of the ~~ordinary~~ normal conductor layer and the ~~superconductor~~ superconducting layer. It is also possible for a single layer superconductor to have the functions of both the ~~absorbent~~ absorber 62 and the resistor 61.

Paragraph beginning at lin 1 of page 22 has b en amend d as follows:

If the resistor 61 and the ~~absorbent~~ absorber 62 are selected as, for example, titanium and gold, they can be made in the following manner. In FIG. 9A, after ~~etching~~ patterning of a silicon nitride film, being the insulating film 59, has been completed, aluminum, being the etching mask ~~B60~~ 60, is removed. It is possible for the aluminum to be etched using an alkali solution. Next, titanium, being the resistor 61, is film formed on the insulating film 59 side. The film formation method is sputtering or vacuum evaporation. After formation of the titanium film, a film of gold is formed without ~~releasing~~ breaking the vacuum. Next, patterning of the gold and titanium is performed using mask exposure. It is possible for the gold to be etched using KI (potassium iodide) + I, and to etch the titanium using the hydrogen fluoride solution. After that, ~~superconductor~~ superconducting wiring 63 is formed as an electrode. It is possible, for example, to use niobium as the ~~superconductor~~ superconducting wiring 63, and for patterning to use a lift-off method.

Paragraph beginning at line 11 of page 23 has been amended as follows:

As described above, a ~~calorimeter,~~ calorimeter has an ~~absorbent,~~ absorber for converting energy of radioactive

rays into heat, and a ~~resistor,~~ resistor for converting heat into an electrical signal using ~~superconductive~~ superconducting ~~transition,~~ transition and arranged on a membrane for determining thermal conductivity, ~~and~~ the membrane ~~is~~ being attached to a substrate~~, the substrate~~ having a tri-layer structure of an etching layer, an etching stop layer and a support substrate~~, and by~~. By providing a hollow at part of the etching layer, depositing a sacrificial layer, flattening a surface of the etching layer, and etching the etching layer from the etching layer side, and by wet etching the etching layer beneath the membrane regardless of the shape of the membrane, it is possible to easily perform etching, and the membrane can be arranged separated by the thickness of the support substrate and the etching layer. Particularly, if the sacrificial layer is amorphous silicon dioxide, it is possible to simply perform etching using hydrogen fluoride, and it is possible to etch the sacrificial layer in a reduced time. By using a substrate having a tri-layer structure, patterning is only performed on one surface, and there is no danger of the pattern surface being contaminated. Also, since only etching layer of the tri-layer structure substrate is etched, the mechanical strength is improved, and it becomes easier to handle.

Paragraph beginning at lin 10 of page 24 has be n amended as follows:

In order to achieve these objects, according to the present invention, by using a calorimeter having an ~~absorbent,~~ absorber for converting energy of radioactive rays into ~~heat~~ thermal energy, and ~~resistor,~~ resistor for converting ~~heat~~ thermal energy into an electrical signal using ~~superconductive~~ superconducting ~~transition,~~ transition and arranged on a membrane for determining thermal conductivity, ~~and having~~ the membrane being attached to a substrate~~, the substrate~~ having a tri-layer structure of an etching layer, an etching stop layer and support substrate, with the membrane being arranged separated by the thickness of the etching stop layer and the etching layer, it is possible to obtain a calorimeter that has large element mechanical strength compared to using the silicon substrate of the related art, and which is suitable for making into an array.

Paragraph beginning at line 25 of page 24 has been amended as follows:

Also, ~~according to~~ the present ~~invention,~~ invention provides a method of manufacturing a calorimeter having an ~~absorbent,~~ absorber for converting energy of radioactive rays into ~~heat~~ thermal energy, and a ~~resistor,~~ resistor for

converting ~~heat~~ thermal energy into an electrical signal using ~~superconductive~~ superconducting transition ~~are~~ arranged on a membrane for determining thermal conductivity, the membrane ~~is~~ being attached to a substrate~~, the substrate has~~ having a tri-layer structure of an etching layer, an etching stop layer and a support substrate, comprising the steps of ~~and by using a step of~~ arranging the membrane in a specified direction and etching the etching layer from the etching layer side, and wet etching the etching layer beneath the ~~membrane,~~ membrane. By this method, it is possible to easily perform etching, and it is possible to arrange the membrane separated by the thickness of the support substrate and the etching layer. In particular, by forming the etching layer from planar (100) oriented silicon, and arranging the orientation of the membrane to <100>, it is made possible to etch the etching layer in a short time. By using a substrate having a tri-layer structure, patterning is only performed on one surface, and there is no danger of the pattern surface being contaminated. Also, since only the etching layer of the tri-layer structure substrate is etched, the mechanical strength is improved, and handling becomes easier.

Paragraph beginning at lin 22 of page 25 has been amend d as follows:

Also, ~~according to~~ the present ~~invention,~~ invention provides a method of manufacturing a calorimeter ~~has~~ having an ~~absorbent,~~ absorber for converting energy of radioactive rays into ~~heat~~ thermal energy, and a ~~resistor,~~ resistor for converting ~~heat~~ thermal energy into an electrical signal using ~~superconductive~~ superconducting ~~transition,~~ transition and arranged on a membrane for determining thermal conductivity, ~~and~~ the membrane ~~is~~ being attached to a substrate~~, the substrate~~ having a tri-layer structure of an etching layer, an etching stop layer and a support substrate, comprising the steps of ~~and by~~ providing a hollow at part of the etching layer, depositing a sacrificial layer, flattening a surface of the etching layer, ~~and~~ etching the etching layer from the etching layer side, and ~~by~~ wet etching the etching layer beneath the membrane regardless of the shape of the ~~membrane,~~ membrane. By this method, it is possible to easily perform etching, and the membrane can be arranged separated by the thickness of the support substrate and the etching layer. Particularly, if the sacrificial layer is amorphous silicon dioxide, it is possible to simply perform etching using hydrogen fluoride, and it is possible to etch the sacrificial layer in a reduced time. By using a substrate having a tri-

layer structure, patterning is only performed on one surface, and there is no danger of the pattern surface being contaminated. Also, since only the etching layer of the tri-layer structure substrate is etched, the mechanical strength is improved, and handling is made easier.